



# SRI KRISHNA INSTITUTE OF TECHNOLOGY

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#57, Chimney Hills, Hesaraghatta Main Road, Chikkabanavara Post, Bengaluru- 560090

## DEPARTMENT OF EE- VLSI DESIGN & TECHNOLOGY

|                     |   |               |             |   |                  |
|---------------------|---|---------------|-------------|---|------------------|
| Academic Year       | : | 2025-26       | Course Name | : | MICROCONTROLLERS |
| Semester            | : | IV            | Course Code | : | BVL405A          |
| Scheme              | : | 2022          | L: T: P: S  | : | 3:0:0:0 Credit:3 |
| Total Contact hours | : | 40            | CIE Marks   | : | 50               |
| Course Plan Author  | : | Mrs.Shwetha R | SEE Marks   | : | 50               |
| Date                | : | 13-02-2026    | Total Marks | : | 100              |

### Course Prerequisites:

- Basic of C programming.

### Learning Objectives:

This course will enable students to:

- Understand the difference between Microprocessor and Microcontroller and embedded microcontrollers.
- Analyze the basic architecture of 8051 microcontroller.
- Program 8051 microcontroller using Assembly Language and C.
- Understand the operation and use of inbuilt Timers/Counters and Serial port of 8051
- Understand the interrupt structure of 8051 and Interfacing I/O devices using I/O ports of 8051

### Course Outcomes:

| CO  | At the end of the course, student should be able to . . .                                                         | Blooms' Level |
|-----|-------------------------------------------------------------------------------------------------------------------|---------------|
| CO1 | : Understand the Architecture of 8051 Microcontroller and comparing with different processor Architecture.        | L2            |
| CO2 | : Apply the concepts of 8051 Microcontroller Addressing modes & Instructions to write Assembly Language Programs. | L3            |
| CO3 | : Illustrate the operation of Timers/Counters for interrupt programming                                           | L3            |
| CO4 | : Develop C programs to interface I/O devices with 8051 Microcontroller.                                          | L3            |

### Blooms' Taxonomy:

| L1          | L2            | L3       | L4        | L5         | L6       |
|-------------|---------------|----------|-----------|------------|----------|
| Remembering | Understanding | Applying | Analyzing | Evaluating | Creating |

### Program Outcomes:

|     |   |                                            |      |   |                                |
|-----|---|--------------------------------------------|------|---|--------------------------------|
| PO1 | : | Engineering knowledge                      | PO7  | : | Environment and sustainability |
| PO2 | : | Problem analysis                           | PO8  | : | Ethics                         |
| PO3 | : | Design/development of solutions            | PO9  | : | Individual and team work       |
| PO4 | : | Conduct investigations of complex problems | PO10 | : | Communication                  |
| PO5 | : | Modern tool usage                          | PO11 | : | Project management and finance |
| PO6 | : | The engineer and society                   | PO12 | : | Life-long learning             |

### Program Specific Outcomes:



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|              |                                                                                                                                                                                                                                                                         |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PSO1:</b> | Graduates will possess advanced knowledge and practical skills in VLSI design including the use of state-of-the-art tools and techniques to develop, analyze and optimize analog, digital and mixed mode systems for real-world applications.                           |
| <b>PSO2:</b> | Graduates will demonstrate the ability to conduct interdisciplinary research in VLSI technologies contributing to innovative solutions that address global challenges while advancing sustainable and inclusive technology                                              |
| <b>PSO3:</b> | Graduates will be equipped with the entrepreneurial mindset and leadership qualities necessary to create innovative solutions in VLSI design, promoting new ventures, generating employment and taking on roles that foster industry collaboration and societal impact. |

## CO-PO-PSO Mapping:

| CO  | Program Outcomes |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
|-----|------------------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|
|     | PO 1             | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO1 2 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | 1                | 1    | 1    | -    | 1    | -    | -    | 1    | -    | -     | -     | -     | 1     | -     | -     |
| CO2 | 1                | 1    | 1    | -    | 1    | -    | -    | 1    | -    | -     | -     | -     | 1     | -     | -     |
| CO3 | 1                | 1    | 2    | -    | 1    | -    | -    | 1    | -    | -     | -     | -     | 1     | -     | -     |
| CO4 | 1                | 1    | 2    | -    | 1    | -    | -    | 1    | -    | -     | -     | -     | 2     | -     | -     |

## Justification:

| CO   | PO  | Mapping Level | Justification                                                                                                                                                                                                               |
|------|-----|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO 1 | PO1 | 1             | CO1 enables students to understand the architecture, memory organization, registers, and functional blocks of the Intel 8051, thereby applying fundamental engineering knowledge in electronics and microprocessor systems. |
|      | PO2 | 1             | Students analyze architectural differences between microcontrollers and processors (Harvard vs. Von Neumann architecture), enhancing their problem analysis and comparison skills.                                          |
|      | PO3 | 1             | Understanding architectural features such as I/O ports, timers, and interrupts forms the basic foundation required for designing embedded system solutions.                                                                 |
|      | PO5 | 1             | Students use simulators, datasheets, and embedded development tools to study the 8051 architecture, contributing to modern tool usage.                                                                                      |



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|           |           |                      |                                                                                                                                                                                                              |
|-----------|-----------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           | PO8       | 1                    | Learning standard embedded system practices and responsible design considerations promotes professional and ethical awareness in engineering applications.                                                   |
|           | PSO<br>1  | 1                    | CO1 strongly supports core program-specific competency in embedded systems by building a solid foundation in microcontroller architecture, which is essential for advanced system design and implementation. |
| <b>CO</b> | <b>PO</b> | <b>Mapping Level</b> | <b>Justification</b>                                                                                                                                                                                         |
| CO<br>2   | PO1       | 1                    | Students apply engineering fundamentals to understand instruction sets, addressing modes, and register operations of the Intel 8051 while developing assembly programs                                       |
|           | PO2       | 1                    | Writing assembly programs requires analyzing logical problems, selecting suitable addressing modes, and optimizing instruction sequences.                                                                    |
|           | PO3       | 1                    | Students design algorithmic solutions and convert them into assembly language programs for embedded applications.                                                                                            |
|           | PO5       | 1                    | Use of assemblers, simulators, and embedded IDE tools for program development supports modern tool usage.                                                                                                    |
|           | PO8       | 1                    | Students follow structured programming practices and responsible debugging methodologies aligned with professional ethics.                                                                                   |
|           | PSO<br>1  | 1                    | Contribution to program-specific competency as students gain hands-on expertise in low-level microcontroller programming essential for embedded systems development.                                         |
| <b>CO</b> | <b>PO</b> | <b>Mapping Level</b> | <b>Justification</b>                                                                                                                                                                                         |
| CO<br>3   | PO1       | 1                    | Students apply knowledge of timer registers, interrupt vectors, and control logic of the Intel 8051.                                                                                                         |
|           | PO2       | 1                    | Configuring timers and interrupts requires analyzing timing requirements and selecting appropriate modes of operation.                                                                                       |
|           | PO3       | 2                    | Strong contribution as students design and implement real-time embedded solutions using timers and interrupt service routines.                                                                               |
|           | PO5       | 1                    | Simulation and testing of timer/counter programs using embedded development tools enhance tool proficiency.                                                                                                  |
|           | PO8       | 1                    | Students ensure reliable and safe interrupt handling, promoting responsible system design practices.                                                                                                         |
|           | PSO<br>1  | 1                    | Domain relevance to timer and interrupt programming are fundamental to real-time embedded system applications.                                                                                               |
| <b>CO</b> | <b>PO</b> | <b>Mapping Level</b> | <b>Justification</b>                                                                                                                                                                                         |
| CO<br>4   | PO1       | 1                    | Students apply microcontroller fundamentals and C programming concepts to interface hardware devices.                                                                                                        |
|           | PO2       | 1                    | Interfacing requires analyzing device specifications and selecting appropriate communication and control methods.                                                                                            |



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|  |       |   |                                                                                                                              |
|--|-------|---|------------------------------------------------------------------------------------------------------------------------------|
|  | PO3   | 2 | Strong contribution as students design complete embedded solutions integrating sensors, actuators, and I/O devices.          |
|  | PO5   | 1 | Use of embedded C compilers, debugging tools, and hardware kits strengthens modern tool usage skills.                        |
|  | PO8   | 1 | Encourages ethical and safe hardware interfacing practices to prevent system failures or device damage.                      |
|  | PSO 1 | 2 | Strong alignment with embedded system specialization through practical implementation of real-time interfacing applications. |

## Course Content (Syllabus)

| Module 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |  | CH |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|----|
| Microcontroller: Microprocessor Vs Microcontroller, Micro controller & Embedded Processors, Processor Architectures-Harvard Vs Princeton & RISC Vs CISC, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.<br>(Text book 1-1.1, Text book 2 1.0, 1.1, 3.0, 3.1, 3.2, 3.3 Text book 3-Pg 5-9)                                                                                                                                     |  |  | 08 |
| RBT: L2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |  |    |
| Module 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |    |
| Instruction Set: 8051 Addressing Modes, Data Transfer Instructions, Arithmetic instructions, Logical Instructions, Jump & Call Instructions Stack & Subroutine Instructions of 8051 (with examples in assembly Language).<br>Textbook 2-Chapter 5, 6, 7, 8<br>Textbook 3, Chapter 3                                                                                                                                                                                                                                   |  |  | 08 |
| RBT: L3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |  |    |
| Module 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |    |
| Timers/Counters & Serial port programming: Basics of Timers & Counters, Data types & Time delay in the 8051 using C, Programming 8051 Timers, Mode 1 & Mode 2 Programming, Counter Programming (Assembly Language only) . (Text book 2- 3.4, Text book 1-7.1, 9.1, 9.2)<br>Basics of Serial Communication, 8051 Connection to RS232, Programming the 8051 to transfer data serially & to receive data serially using C.<br>( Text book 2- 3.5, Text book 1- 10.1, 10.2, 10.3 except assembly language programs, 10.5) |  |  | 08 |
| RBT: L3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |  |    |
| Module 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |    |
| Interrupt Programming: Basics of Interrupts, 8051 Interrupts, Programming Timer Interrupts, Programming Serial Communication Interrupts, Interrupt Priority in 8051 (Assembly Language only)<br>Text book 2- 3.6, Text book 1- 11.1, 11.2, 11.4, 11.5                                                                                                                                                                                                                                                                 |  |  | 08 |
| RBT: L3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |  |    |
| Module 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |    |
| I/O Port Interfacing & Programming: I/O Programming in 8051 C, LCD interfacing, DAC 0808 Interfacing,                                                                                                                                                                                                                                                                                                                                                                                                                 |  |  | 08 |



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ADC 0804 interfacing, Stepper motor interfacing, DC motor control & Pulse Width Modulation (PWM) using C only.

Textbook 1: 7.2, 12.1, 13.1, 13.2, 17.2, 17.3

**RBT: L3**

## Schedule of Instruction:

| Class No                               | Topic                                                          | Date     | RBT | CO | Mode         |
|----------------------------------------|----------------------------------------------------------------|----------|-----|----|--------------|
| <b>Module-1 :</b>                      |                                                                |          |     |    |              |
| <b>Introduction to microcontroller</b> |                                                                |          |     |    |              |
| 1.                                     | Introduction to microcontroller                                | 23/02/26 | L2  | 1  | L            |
| 2.                                     | Microcontroller: Microprocessor Vs Microcontroller             | 24/02/26 | L2  | 1  | L            |
| 3.                                     | Processor Architectures                                        | 25/02/26 | L2  | 1  | NPTEL Videos |
| 4.                                     | Harvard Vs Princeton & RISC Vs CISC                            | 27/02/26 | L2  | 1  | L            |
| 5.                                     | Micro controller & Embedded Processors                         | 02/03/26 | L2  | 1  | L            |
| 6.                                     | 8051 Architecture- Registers, Pin diagram, I/O ports functions | 03/03/26 | L2  | 1  | L            |
| 7.                                     | Internal Memory organization                                   | 04/03/26 | L2  | 1  | L            |
| 8.                                     | External Memory (ROM & RAM) interfacing.                       | 06/03/26 | L2  | 1  | L            |
| 9.                                     | Revision (VTU question papers)                                 | 09/03/26 | L2  | 1  | Discussion   |
| <b>Module-2</b>                        |                                                                |          |     |    |              |
| <b>Instruction Set:</b>                |                                                                |          |     |    |              |
| 10.                                    | Instruction Set: 8051 Addressing Modes                         | 10/03/26 | L3  | 2  | L            |
| 11.                                    | Addressing Modes, Data Transfer Instructions                   | 20/03/26 | L3  | 2  | L            |
| 12.                                    | Data Transfer Instructions                                     | 23/03/26 | L3  | 2  | L            |
| 13.                                    | Arithmetic instructions                                        | 24/03/26 | L3  | 2  | Simulation   |
| 14.                                    | Arithmetic instructions, Logical instruction                   | 25/03/26 | L3  | 2  | Simulation   |
| 15.                                    | Logical Instructions                                           | 27/03/26 | L3  | 2  | L            |



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| Class No                                             | Topic                                                                             | Date     | RBT | CO | Mode              |
|------------------------------------------------------|-----------------------------------------------------------------------------------|----------|-----|----|-------------------|
| 16.                                                  | Jump & Call Instructions Stack & Subroutine Instructions of 8051.                 | 30/03/26 | L3  | 2  | L                 |
| 17.                                                  | Assembly language examples                                                        | 01/04/26 | L3  | 2  | Flipped classroom |
| 18.                                                  | Revision(VTU Question papers)                                                     | 06/04/26 | L3  | 2  | Discussion        |
| <b>Module-3:</b>                                     |                                                                                   |          |     |    |                   |
| <b>Timers/Counters &amp; Serial port programming</b> |                                                                                   |          |     |    |                   |
| 19.                                                  | Basics of Timers & Counters                                                       | 07/04/26 | L3  | 3  | L                 |
| 20.                                                  | Data types & Time delay in the 8051 using C,                                      | 08/04/26 | L3  | 3  | L                 |
| 21.                                                  | Programming 8051 Timers, Mode 1 & Mode 2 Programming                              | 13/04/26 | L3  | 3  | L                 |
| 22.                                                  | Counter Programming (Assembly Language only)                                      | 15/04/26 | L3  | 3  | Simulation        |
| 23.                                                  | Basics of Serial Communication                                                    | 17/04/26 | L3  | 3  | L                 |
| 24.                                                  | 8051 Connection to RS232                                                          | 27/04/26 | L3  | 3  | L                 |
| 25.                                                  | Programming the 8051 to transfer data serially & to receive data serially using C | 28/04/26 | L3  | 3  | Simulation        |
| 26.                                                  | Programs                                                                          | 29/04/26 | L3  | 3  | Flipped classroom |
| 27.                                                  | Revision(VTU Question Papers)                                                     | 04/05/26 | L3  | 3  | Discussion        |
| <b>Module-4:</b>                                     |                                                                                   |          |     |    |                   |
| <b>Interrupt Programming</b>                         |                                                                                   |          |     |    |                   |
| 28.                                                  | Basics of Interrupts                                                              | 05/05/26 | L3  | 3  | L                 |
| 29.                                                  | Basics of Interrupts,8051 Interrupts                                              | 06/05/26 | L3  | 3  | L                 |
| 30.                                                  | 8051 Interrupts                                                                   | 08/05/26 | L3  | 3  | L                 |
| 31.                                                  | 8051 programming timer interrupts                                                 | 11/05/26 | L3  | 3  | L                 |
| 32.                                                  | 8051 programming timer interrupts                                                 | 12/05/26 | L3  | 3  | Simulation        |
| 33.                                                  | 8051 Programming Timer Interrupts                                                 | 13/05/26 | L3  | 3  | L                 |
| 34.                                                  | Programming Serial Communication Interrupts                                       | 15/05/26 | L3  | 3  | L                 |
| 35.                                                  | Interrupt Priority in 8051(Assembly Language only)                                | 18/05/26 | L3  | 3  | L                 |
| 36.                                                  | Revision(VTU Question papers)                                                     | 19/05/26 | L3  | 3  | Discussion        |



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| Class No                                      | Topic                                                         | Date     | RBT | CO | Mode   |
|-----------------------------------------------|---------------------------------------------------------------|----------|-----|----|--------|
| <b>Module-5:</b>                              |                                                               |          |     |    |        |
| <b>I/O Port Interfacing &amp; Programming</b> |                                                               |          |     |    |        |
| 37.                                           | I/O Programming in 8051 C                                     | 25/05/26 | L3  | 4  | L /PPT |
| 38.                                           | LCD interfacing                                               | 26/05/26 | L3  | 4  | L /PPT |
| 39.                                           | DAC 0808 Interfacing                                          | 29/05/26 | L3  | 4  | L /PPT |
| 40.                                           | DAC 0808 Interfacing                                          | 01/06/26 | L3  | 4  | L PPT  |
| 41.                                           | Stepper motor interfacing                                     | 02/06/26 | L3  | 4  | L /PPT |
| 42.                                           | ADC 0804 interfacing                                          | 03/06/26 | L3  | 4  | L /PPT |
| 43.                                           | ADC 0804 interfacing                                          | 05/06/26 | L3  | 4  | L /PPT |
| 44.                                           | DC motor control & Pulse Width Modulation (PWM) using C only. | 12/06/26 | L3  | 4  | L      |

## Textbooks:

|    |                                                                                                                                                                           |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| T1 | The “8051 Microcontroller and Embedded Systems – Using Assembly and C”, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollind. Mckinlay; Phi, 2006 / Pearson, 2006. |
| T2 | The 8051 Microcontroller”, Kenneth j. Ayala, 3rd edition, Thomson/Cengage Learning.                                                                                       |
| T3 | “Programming And Customizing The 8051 Microcontroller”. ,Myke Predko Tata Mc Graw-Hill Edition 1999 (reprint 2003)                                                        |

## Reference books:

|    |                                                                                                                   |
|----|-------------------------------------------------------------------------------------------------------------------|
| R1 | “The 8051 Microcontroller Based Embedded Systems”, Manish K Patel, McGraw Hill, 2014, ISBN: 978-93-329-0125-4.    |
| R2 | “Microcontrollers: Architecture, Programming, Interfacing and System Design”, Raj Kamal, Pearson Education, 2005. |

## Web links and Video Lectures (e-Resources):

|    |                                                                                                                                                                                                  |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. | <a href="https://sites.google.com/skit.org/in/microcontroller-4th-semvlsi/about-the-course">https://sites.google.com/skit.org/in/microcontroller-4th-semvlsi/about-the-course</a> (website link) |
| 2. | <a href="https://youtu.be/QGg5jZEdT7A?si=sO2Js6RwRarR2ksg">https://youtu.be/QGg5jZEdT7A?si=sO2Js6RwRarR2ksg</a> – Comparison of microcontroller and microprocessor                               |
| 3. | <a href="https://youtu.be/7YW-0dPq11o?si=RKXUnqbWnU610p4m">https://youtu.be/7YW-0dPq11o?si=RKXUnqbWnU610p4m</a> –Addressing modes                                                                |
| 4. | <a href="#">Timer and Counter in 8051 Microcontroller Explained: ISR Address, Working, and Functionality</a> -Timers                                                                             |
| 5. | <a href="https://youtu.be/x4eBYZ52Vgo?si=t8eioQ27xXYz4Xhl">https://youtu.be/x4eBYZ52Vgo?si=t8eioQ27xXYz4Xhl</a> – Interrupts in 8051                                                             |
| 6. | <a href="https://youtu.be/w4r9AQUtmeg?si=9OSoj3G85zbnJkux">https://youtu.be/w4r9AQUtmeg?si=9OSoj3G85zbnJkux</a> – Interfacing                                                                    |

## Assessment Schedule:

| S.N. | Assessment Type | Content            | CO    | Duration  | Marks | Date     |
|------|-----------------|--------------------|-------|-----------|-------|----------|
| 1.   | CIE Test 1      | Module 1,2,3(Half) | 1,2,3 | 1hr-30min | 50M   | 22/04/26 |
| 2.   | CIE Test 2      | Module 3(Half),4,5 | 3,4   | 1hr-30min | 50M   | 09/06/26 |



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|    |                          |                  |         | Avg Reduced to | 25M                   |          |
|----|--------------------------|------------------|---------|----------------|-----------------------|----------|
| 3. | Unit test                | Module 1,2,3,4   | 1,2,3   | 1hr            | 10M                   | 16/04/26 |
| 4. | Seminar/Project          | Module 5         | 3,4     | 10min          | 15M                   | 13/05/26 |
|    |                          |                  |         | Total=         | 25                    |          |
|    |                          |                  |         | Total=         | (25+25)=50M           |          |
| 5. | Semester End Examination | Module 1,2,3,4,5 | 1,2,3,4 | 03hours        | 100(scale down to 50) |          |

**Faculty In charge**

**Course Coordinator**

**HoD**